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MINIMIZATION  
OF  
CARPAL TUNNEL SYNDROME

DLA900-87-D-0017, DO 0015

FINAL REPORT

by

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13. ABSTRACT (Maximum 200 words) The objectives of this report was to develop an attachment and method to reduce the risk of Carpal Tunnel Syndrome on a side seam operation called French Felling. In addition, the research assisted in identifying the cause of the high incidence of CTS in French Felling operators and a workstation device was designed to minimize its occurrence.				
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## INTRODUCTION

French Felling is a two operation side seaming function which is common on higher priced men's dress shirts. Normal processing uses a typical, flat-bed industrial sewing machine on both operations. Since the first operation closes the side seam, the second operation requires that the operator's hands are bent downward in an abnormal manner. Over a period of months, this abnormal wrist, hand and arm positioning can result in Carpal Tunnel Syndrome. Because the French Felling design is a popular feature on dress shirts, this has become a serious problem for each of the major United States dress shirt manufacturers.

Figures 1,2,3 and 4 show this abnormal hand, wrist and arm positioning as this operation is done on a typical "flat bed" machine with a standard pressure foot. Figures 5 and 6 show the total workstation.

The purpose of this project was to identify the cause of this high incidence of Carpal Tunnel Syndrome and to design a work station device that will minimize its occurrence.

## FRENCH FELLING CARPAL TUNNEL MINIMIZATION DEVICE DEVELOPMENT

Beginning in January 1990, efforts were concentrated on the development of a foot and guiding mechanism which will minimize Carpal Tunnel Syndrome at the second French Felling operation on men's dress shirts. The device, called the **French Felling Foot and Guide**, was developed by Mr. Elroy Pierce, a Clemson Apparel Research Engineering Technician. To coordinate his efforts with Industrial supply companies serving the US Apparel industry, he worked with Atlanta Attachments and Bottoms and Associates both located in Atlanta, GA. These companies built the prototype devices and helped in the development and perfection. Bottoms & Associates is now selling the completed design to the industry. The mechanism cost is set at less than \$200.00 per unit. The foot and guiding mechanism allows the operators hands to be positioned without abnormal bending of the wrists. Quality and speed of the operation can also be improved. Engineering drawings of the completed device are included in the appendix of this report. Figures 7, 8 and 9 show the device mounted on a flat bed machine. Figures 10, 11, 12, 13, and 14 show an operator using the device to complete the french felling operation. Note the wrist, fingers and arms are held in a normal position throughout the cycle.

The device is now available for purchase from:

Bottoms & Associates, Inc.

P.O. Box 264

Route 2, Highway 341-S

Barnesville, GA 30204

Statement A per telecon  
Helen Kerlin DLA/AQPOT  
Alexandria, VA 22304-6100

### FIELD TESTING

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Mr. Pierce also arranged for the installation of the prototype units at the following US apparel companies each of which is a member of the CAR Steering Committee:

Hathaway Shirt Company, Waterville, ME

Oxford Industries, Vidalia, GA

Capital Mercury Shirt Company, Marshall, AR

Phillips/Van Heusen, Ozark, AL.

Each of these companies produces a dress shirt using the French Felling styling and each has had Carpal Tunnel Syndrome worker's compensation claims on that operation prior to the installation of the **French Felling Foot and Guide**. Each company had had at least one claim and other operators were complaining that this operation caused them to position their hands, wrists and arms in an abnormal manner resulting in pain and potential injury.

Mr. Pierce visited several of these plants in order to install the device and train the operators, technicians and supervisors on the proper use of the system. It was felt that extensive field testing was necessary in order to make improvements to the system and gather information over an extended period of time to determine the actual effectiveness relative to the minimization of Carpal Tunnel Syndrome.

The field testing documented a marked change in position of operator hands during the sewing cycle which will minimize the possibility of Carpal Tunnel Syndrome. There is not only a reduction in fatigue and stress, but also an increase in productivity. Further, there has been a noticeable improvement in product quality according to the managers of each plant.

Indications continued that the device does have a positive effect on the incidence of Carpal Tunnel Syndrome in that the operator hands and wrists

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are allowed to be positioned in a more normal configuration in the sewing cycle. Throughout the field testing of the device and to date, none of the operators using this device have developed the symptoms of Carpal Tunnel Syndrome. There have been no workers compensation claims from any plant using the device.

The following productivity improvements were documented during the testing phase of this project and have been confirmed as continuing to date:

<u>Company</u>	<u>Production per Day in units</u>		
	<u>Previous</u>	<u>Revised</u>	<u>% Improvement</u>
Hathaway Shirt	504	744	47.6
Van Heusen	516	670	29.8
Capital Mercury Shirt	550	700	27.3
Oxford Industries	535	652	22.0

#### **OTHER PRODUCT TESTING**

On January 4, 1990, Mr. Peter Zanetti of Durkopp-Adler America visited CAR concerning a single-needle "post" machine which is applicable to the French Felling operation. A "post" machine differs from a normal "flat bed" machine in that the table surface of the machine is replaced by a single post directly under the needle and foot. On an operation such as French Felling, the tube formed by the side seam on the sleeve can be pushed down over the post so that there is less accumulation of bulk around the needle during the sewing process. While the application of this machine seems to be desirable for this operation, the judgment is that it is too expensive at about \$9,000 per unit. The Durkopp Adler America demonstration unit was sent to Capital Mercury Shirt Company in Marshall, AR for testing. Their conclusion was consistent with the initial judgment of the CAR engineering staff that while some improvement in operator hand positioning was accomplished, the unit is not cost effective when the same improvement can be accomplished with the workstation device designed by CAR at a cost of \$200 per unit.

#### **CAR STAFF TRAINING**

In order to assure the correct knowledge was attained for the CAR staff in the development of the device, staff members attended several training

seminars within the apparel industry. On August 21, 1990, Elroy Pierce and Randy Rowland attended a seminar on Ergonomic Principles for the Apparel Plant at the Georgia Institute of Technology in Atlanta, GA. This seminar provided information not only on the minimization of Carpal Tunnel Syndrome, but also on the minimization of other repetitive motion disorder concerns for apparel operations.

October 23 - 25, 1990, Mr. Randy Rowland and Mr. Elroy Pierce attended a Repetitive Motion Conference at Auburn University. This conference dealt with the control and prevention of musculoskeletal injuries due to highly repetitive jobs and work environments in the textile and apparel industries. The conference brought together key national personalities from the government, management, medical, legal, labor, and academia to address the repetitive motion problems. Judging from the attendees of this conference (over 200 people) the textile and apparel industries are very aware of the musculoskeletal disorders that they will face in the future.

#### **OTHER ERGONOMIC EFFORTS**

During November, fifty ergonomically designed chairs were donated to Clemson Apparel Research by Adjusto Corporation. These chairs are very well designed. They will help to reduce back fatigue and increase productivity.

Also as a result of the work on minimizing Carpal Tunnel Syndrome in the US apparel industry, the need became obvious for developing a device using speech recognition to control sewing machines. The increased popularity of Modular Manufacturing has resulted in many operations converting to a standing posture. In this position, the present state-of-the-art technology uses foot controls to activate the sewing machine. As a result, many sewing operators are experiencing back and hip injuries from shifting most of their weight to one leg. The ergonomic impact of such a device to be used in stand-up operations or as an aid to the handicapped is a very practical application.

In a joint effort with Clemson Apparel Research, EFKA of America and Inotech, a successful prototype using speech recognition to control sewing equipment was constructed in August 1991. This device uses verbal commands to activate a sewing machine. This type of equipment can be very beneficial in a modular or handicapped environment. Defense Logistics Agency funding was awarded to develop a commercially viable product. That device, called Voice Actuated

Sewing Technology (VAST), was first demonstrated at the 1991 Bobbin Show in Atlanta, GA. and is now available to the industry from EFKA of America.

## **CAR ERGONOMIC SEMINARS FOR THE US APPAREL INDUSTRY**

Realizing the need to educate the industry on ergonomic principles, CAR conducted several seminars addressing how to identify and prevent ergonomic problems.

On October 16 and 17, 1991, Clemson Apparel Research conducted a seminar entitled "Ergonomics for the Apparel Industry". The seminar included the following discussions :

### **Occupational Safety and Health Administration Compliance**

Ms. Cynthia Wolf, the Assistant Regional Administrator (Atlanta, Ga.) for the department of OSHA.

### **Legal Views**

Mr. Pat Tyson, partner in the Atlanta based labor law firm of Constangy, Brooks and Smith.

### **Injuries of the Back and Upper Extremity**

Mrs. Jan Braunstein, Director of Peachtree Physical Therapy, Atlanta, Ga.

### **Solutions to Ergonomic Problems**

Mr. Michael Seay, Senior Consulting Engineer with Auburn Engineers Inc.

### **Ergonomic Seating in the Apparel Industry**

Ms. Sandra Smithson, Consulting Engineer with Auburn Engineers Inc.

### **Apparel Manufacturing Accidents and Controls**

Mr. Bryant Blake, Technical Director of Loss Prevention for Liberty Mutual Insurance Company.

### **"A Stitch In Time" Training Manual and Video for Apparel Supervisors**

Mr. Dan Ortiz, Head of the Georgia Tech Research Institute's Environmental Sciences Branch.

### **Clemson Study on Ergonomic Chairs**

Dr. Jack Peck, Principal Investigator for Clemson Apparel Research.

### **The Levi Strauss Ergonomic Program**

Mr. Art Hill, Ergonomic Engineering Manager for Levi Strauss & Co's Domestic operations.

Attending this seminar were over eighty managers and engineers from the US apparel industry.

On November 19 and 20, 1991 Clemson Apparel Research conducted a seminar titled "Fundamentals of Apparel Manufacturing". One of the presentations in this seminar was "Ergonomic Principles" conducted by Mr. Randy Rowland. In this presentation topics such as Carpal Tunnel Syndrome, cumulative trauma disorders, ergonomic seating and OSHA involvement were discussed.

A paper titled "The Minimization of Carpal Tunnel Syndrome" was prepared for the Third Annual Academic Apparel Research Conference at The Southern Technical Institute in Marietta, GA. At this conference Mr. Ed Hill presented the paper and report on the status of the carpal tunnel project. Also discussed were points to consider when beginning an ergonomics program, such as: safety habits, work tolerance limits, medical management, training and education, human capacities, capabilities and limitations.

During the week of March 4th, 1992, Georgia Institute of Technology presented a seminar on Ergonomics for the apparel industry. Mr. Dan Ortiz requested that CAR send before and after photographs of the French Felling operation using the conventional method and Mr. Pierce's guide. Mr. Ortiz used these photographs as a part of his presentation at the seminar.

March 17 & 18, 1992, Clemson Apparel Research conducted a two-day conference on "Advanced Apparel Flexible Manufacturing Systems". Mr. Randy Rowland presented a paper entitled "Modular Ergonomic Concerns". In this presentation, topics such as Carpal Tunnel Syndrome, sit vs. stand, cumulative trauma disorders and workstation design were discussed.

On Thursday, March 19, 1992, CAR presented a seminar entitled "Basic Ergonomics for the Apparel Industry". The topic of discussion were causes, costs, and prevention of cumulative trauma disorders. Also included were the latest innovations in ergonomic work aids. This seminar was the opening seminar for the Southeastern Apparel Manufacturers Association's annual trade



show. Also on display at the SEAM show was the Clemson Apparel Research invention Voice Actuated Sewing Technology (VAST).

Mr. Randy Rowland was the chairperson for an ergonomics workshop held at Clemson Apparel Research in April 1992. This was the second seminar of its type held at CAR.

The presentations included:

**Legal Views, Mr. Neil Wasser**

**The Americans with Disabilities Act, Mr. Larry Bridgesmith**

**Injuries of the Upper Extremity, Ms. Sheila Griffin**

**Solutions to Ergonomic Problems, Mr. Michael Seay**

**The OshKosh Ergonomic Story, Ms. Pat Hirschberg**

**Apparel Manufacturing Accidents and Controls, Mr. Bryant  
Blake**

**"A Stitch in Time", Mr. Dan Ortiz**

**Ergonomic Lighting for the Apparel Industry, Mr. Alex Pratt**

**Voice-Activated sewing Technology (VAST), Mr. Randy  
Rowland and Dr. Jack Peck.**

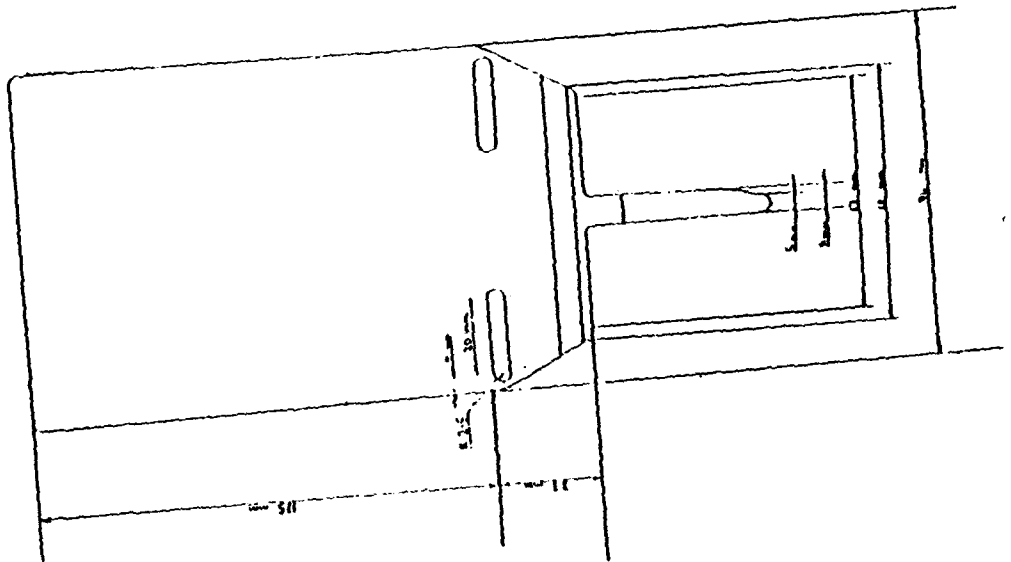
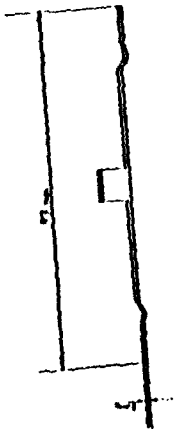
**"Modular Ergonomic Concerns"**

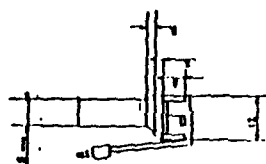
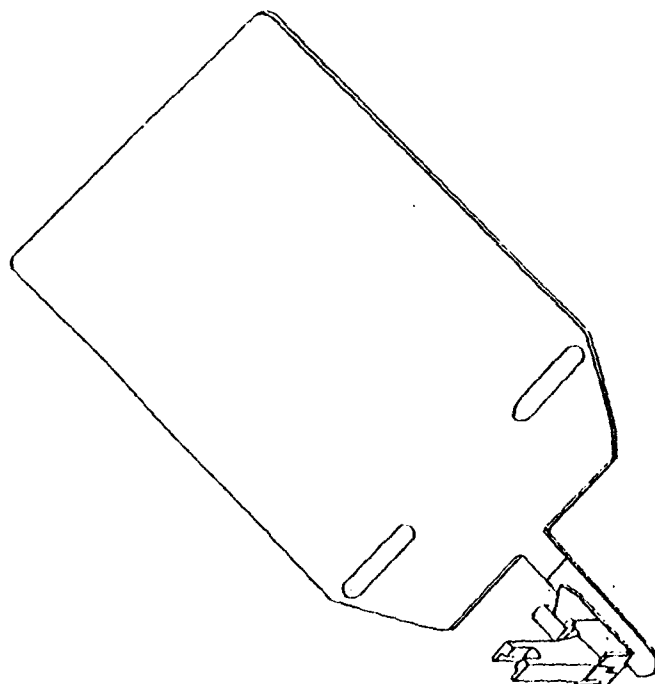
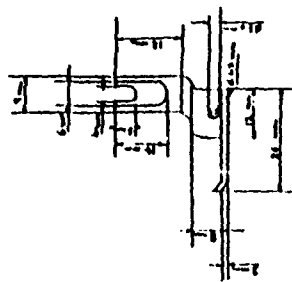
**Mr. Randy Rowland, Clemson Apparel Research**

This seminar was attended by seventy executives of the apparel industry.

## CONCLUSION

Although we have been successful in minimizing Carpal Tunnel Syndrome for this particular operation, there is still much work to be done in the field of ergonomics concerning this disorder and many others like it in the apparel business. The American Apparel Manufacturers Association projected that the average cost of treating each case of Carpal Tunnel Syndrome will cost the manufacturers \$10,000 to \$15,000 providing that it is a curable case and no permanent damage is done. The device invented by Mr. Elroy Pierce has accomplished its objective in that none of the operators who have been using the device has developed any of the classic Carpal Tunnel Syndrome symptoms. The device has caused an improvement in quality as well as an increase in productivity on that operation.





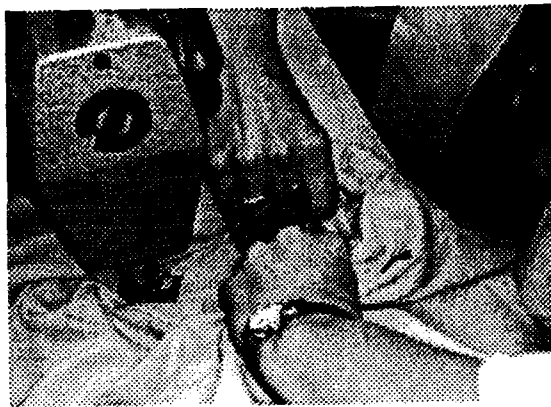


FIGURE 1



FIGURE 2

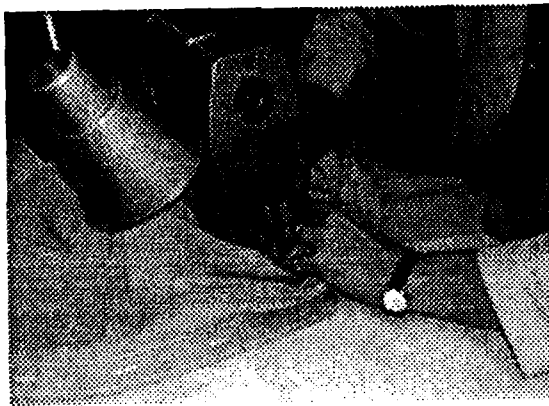


FIGURE 3

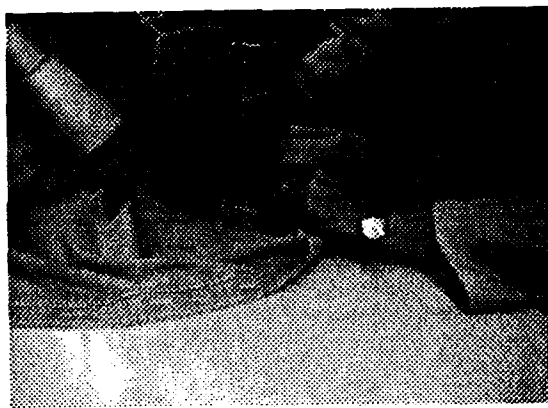


FIGURE 4



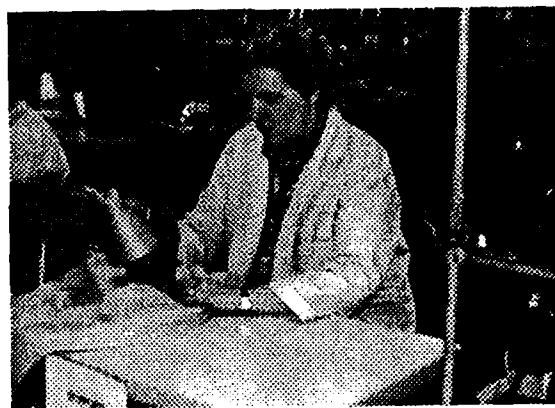


FIGURE 5

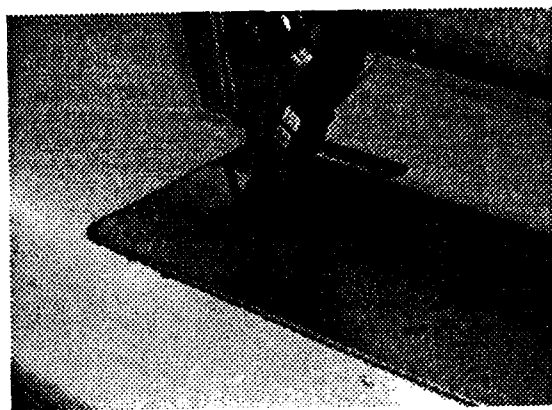


FIGURE 6

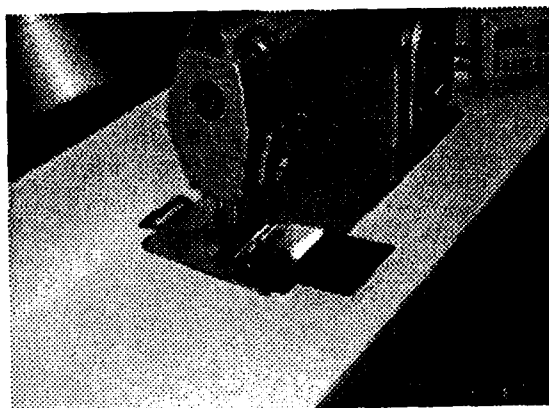


FIGURE 7

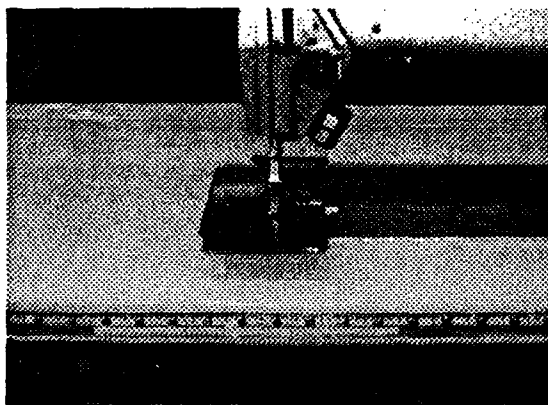


FIGURE 8

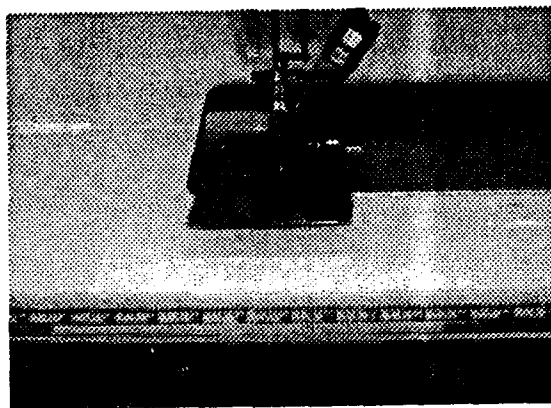


FIGURE 9



FIGURE 10



FIGURE 11



FIGURE 12





FIGURE 13



FIGURE 14